



FACT SHEET

UNITED STATES AIR FORCE

The Inertial Upper Stage



A Boeing Inertial Upper Stage two-stage rocket motor.
Photo: The Boeing Company

The Inertial Upper Stage has successfully placed more than 21 nationally critical satellites and interplanetary payloads into space. The Air Force Space and Missile Systems Center is the executive agent for all Defense Department activities pertaining to the IUS and provides the upper stage booster to NASA for space shuttle use. The Inertial Upper Stage rocket motor provides the U.S. government with the ability to place satellites up to 5,300 pounds into geosynchronous orbit and 8,000 pounds out of Earth's gravitational field using the Air Force Titan IVB rocket or NASA Space Shuttle.

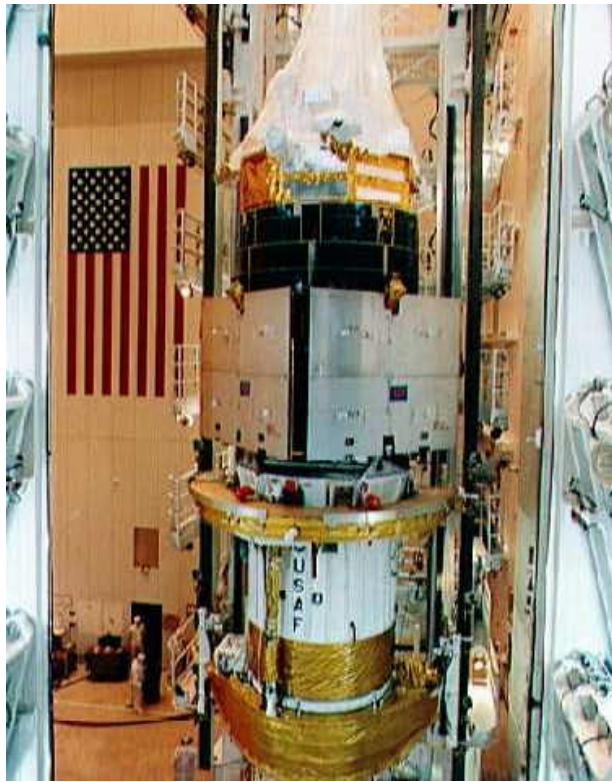
The prime contractor for the Inertial Upper Stage is Boeing Space & Communications in Seal Beach, California. The Boeing IUS production facility is located in Kent, Washington. Boeing began development of the two-stage payload delivery vehicle in 1976 and saw the first IUS fly on a Titan launch vehicle in 1982. The fundamental elements of the IUS include: two high-performance solid-rocket motors; an interstage; an equipment support section that includes the redundant avionics for guidance, navigation, and communications; a reaction control system; and an electrical power system. The IUS is almost 17 feet long, up to 9½ feet in diameter and weighs approximately 32,500 pounds.

The Air Force has used the IUS to boost missile warning and communications satellites into operational orbits. The Defense Support Program satellites have

used the IUS on both the space shuttle (STS-44) and expendable Titan launch vehicles, and a Defense Satellite Communications System spacecraft used an IUS on Space Shuttle Flight 51 to reach operational orbit. In addition, the IUS was selected by NASA as an upper stage for its Tracking and Data Relay Satellite constellation and the prominent Magellan, Galileo, Ulysses, and Chandra science missions. Launched in May 1989, the Magellan spacecraft traveled to Venus and successfully mapped more than 85% of the planet's surface. The Galileo spacecraft was launched in October 1989, and is continuing its mission to explore and send back crucial data on the giant of the solar system – the planet Jupiter. In October 1990, the IUS sent the solar explorer Ulysses, a European Space Agency spacecraft, toward a polar orbit of the sun. Finally, in 1999, an IUS put the orbiting space observatory Chandra into orbit.

A typical Titan IVB launch works this way: about nine minutes into flight, the Titan second stage booster separates from the IUS. The IUS takes over responsibility for the remainder of the powered portion of the flight. For the next 6 hours and 54 minutes, the IUS autonomously performs all functions to place the spacecraft into its proper orbit, approximately 22,000 miles above the Earth. The first IUS rocket burn comes a

little over one hour into the IUS booster flight. The IUS second solid rocket motor ignites around 6 1/2 hours into the flight, followed by an additional coast phase and payload separation.



The Inertial Upper Stage is mated with the Defense Support Program satellite for launch from the Space Shuttle Atlantis. NASA photo

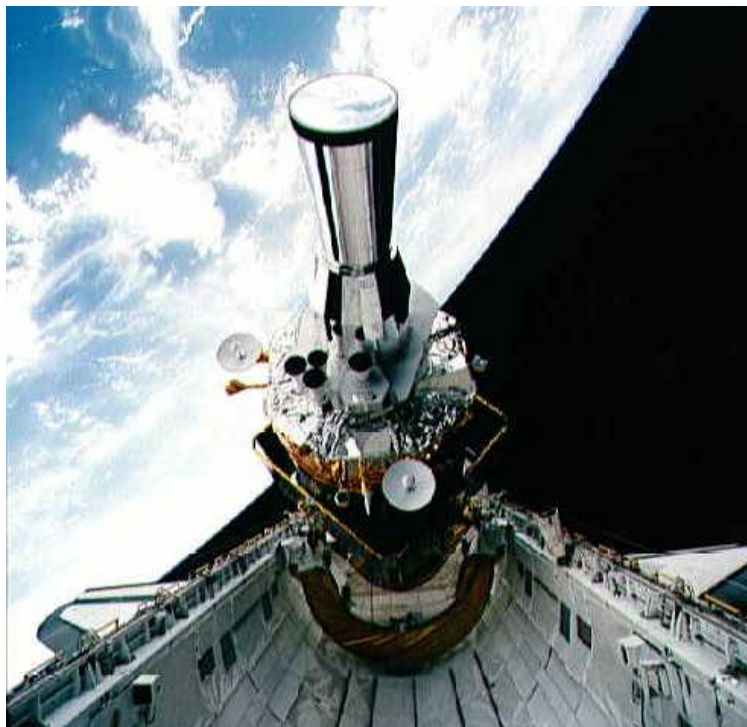
In addition to firing its two stages, the IUS also performs “rotisserie-like” roll maneuvers to protect the satellite from damage due to extreme heat or cold prior to spacecraft separation.

For a typical space shuttle flight, after reaching low-Earth orbit, the shuttle opens its payload doors and the IUS is rotated into deployment position using the IUS-compatible Aerospace Support Equipment. After satellite and IUS checkout, the shuttle astronauts eject the IUS and its cargo from the orbiter. The IUS onboard computers then direct a series of preparatory maneuvers and fire the first-stage motor for approximately 140 seconds to propel the IUS and spacecraft toward the desired geosynchronous position.

After a coast period of several hours, the second-stage motor burns for approximately 100 seconds and injects the IUS into a final circularized orbit. The IUS then separates from the satellite and moves to a position where it neither collides with nor contaminates the satellite.

The Air Force has three IUS vehicles in remaining inventory. Currently, two of these vehicles are manifested to fly nationally critical Defense Support Program satellites in summer 2001 and spring 2003.

Data on the Inertial Upper Stage



DSP-16 and the IUS booster are checked out in the cargo bay of Space Shuttle Atlantis prior to release. NASA photo

Primary mission:

Boost payloads to geosynchronous orbit

Prime Contractor:

The Boeing Company

Length: 16.4 feet

Diameter: Flares from 7.5 to 9.5 feet

Thrust:

SRM-1: 41,700 pounds

SRM-2: 17,200 pounds

Propellants: Solid - Cast Hydroxyl-Terminated Polybutadiene, Aluminum, and Ammonium Perchlorate

Total Boosters built: 25